reached. This constancy of atomic weight, however, only proves that the original body has been split up by the fractionating process into two molecular groupings capable of resisting further decomposition by that identical process; but these groupings are not unlikely to break up when a different fractionating process is brought to bear on them, as I found in the separation of didymium and samarium when using dilute ammonia as the fractionating precipitant. In my paper on "Radiant Matter Spectroscopy" I said ("Part II., Samarium," Phil. Trans. Roy. Soc., Part 2, p. 129, June 18, 1885):—"After a time a balance seems to be established between the affinities at work, when the earth would appear in the same proportion in the precipitate and the solution. At this stage they were thrown down by ammonia, and the precipitated earths set aside to be worked up by the fusion of their anhydrous nitrates so as to alter the ratio between them, when fractionation by ammonia could be again employed."

It is obvious that when the balance of affinities here spoken of was reached, the atomic weight of the mixture under treatment would have become constant, and no further fractionation would have caused the atomic weight to alter.

Atomic weight determinations are valuable in telling when the fractionating operation in use has effected all the separation it can: at this point it becomes constant. The true inference is, not that a new earth has been obtained, but simply that the fractionating operation requires changing for another, which will cleave the group of meta-elements in a different direction.

Meantime, I have kept strictly in view the question, What is an element, and how shall it be recognized when met?

On this subject I beg to submit the following considerations, which, primarily referring to didymium, may at any moment apply to other cases:—

Neodymium and praseodymium are simply the products into which didymium is split up by one particular method of attack.

It must be remembered that a single operation, be it crystallization, precipitation, fusion, partial solution, &c., can only separate a mixture of several bodies into two parts, just as the addition of a reagent only divides a mixture into two portions, a precipitate and a solution, and these divisions will be effected on different lines according to the reagent employed. We add, *e.g.*, ammonia to a mixture, and at once get a separation into two parts. Or we add, say, oxalic acid to the same original solution, and we then split up the mixture into two other parts differently arranged.

Thus by crystallizing didymium nitrate (in Auer's way) we divide the components into two parts. By fusing didymium nitrate we divide its components in a different way; but so long as different methods of attack split up a body differently, it is evident that we have not yet got down to "bed rock."

Further, a compound molecule may easily act as an element. Take the case of didymium, which is certainly a compound, whether the products of Auer's operation be final or not. Didymium has a definite atomic weight; it has well-defined salts, and has been subjected to the closest scrutiny by some of the ablest chemists in the world. I refer particularly to Clève's classical memoir. Still the compound molecule known as didymium was too firmly held together to act otherwise than as an element, and as a seeming element it emerged from every trial. The simple operations to which it had been submitted in the preparation of its salts, and in its purification from other compound molecules, such as samarium and lanthanum, were not sufficient to split it up further. But subjected to a new method of attack it decomposes at once.

We have, in fact, a certain number of reagents, operations, processes, &c., in use. If a body resists all these, and behaves otherwise as a simple substance, we are apt to take it at its own valuation and to call it an element. But for all that it may, as we see, be compound, and as soon as a new and appropriate method of attack is devised, we find it can be split up with comparative ease. Still, we must never forget that, however complex, it can hardly be resolved into more than two parts at one operation.

From considerations above laid down I do not feel in a position to recognize neodymium and praseodymium as elements. We need some criterion for an element which shall appeal to our reason more clearly than the old untrustworthy characteristic of having not as yet been decomposed; and to this point I must beg to call the special attention of my colleagues. It may be that whatever body gives only one absorption band is an element, but we cannot conversely say that an element may be known by its giving only one absorption band, since most of our elements give no bands at all!

Until these important and difficult questions can be decided, I have preferred to open what may be figuratively called a suspense account, wherein, as I have previously suggested, we may provisionally enter all these doubtful bodies as "meta-elements."

But these meta-elements may have more than a mere provisional value. Besides compounds, we have hitherto recognized merely ultimate atoms or the aggregations of such atoms into simple molecules. But it becomes more and more probable that between the atom and the compound we have a gradation of molecules of different ranks, which, as we have seen, may pass for simple elementary bodies. It might be the easier plan, so soon as a constituent of these earths can be found to be chemically and spectroscopically distinguishable from its next of kin, to give it a name and to claim for it elemental rank; but it seems to me the duty of a man of science to treat every subject, not in the manner which may earn for him the greatest temporary κῦδος, but in that which will be of most service to science.

If the study of the rare earths leads us to clearer views on the nature of the elements, neither my colleagues nor myself will, I am sure, regret the months spend in tedious and apparently wearisome fractionations. No one can be more conscious than myself how much ground is yet uncovered, and how many radical questions have received but very inadequate answers. But we can only work on, "unresting, unhasting," trusting that in the end our work will throw some white light upon this deeply interesting department of chemical physics.

NOTES.

A MOST important and profoundly interesting letter from Mr. Stanley to the Chairman of the Emin Pasha Relief Committee has been published this week. It is dated Bungangeta Island, Ituri River, or Aruwimi River, August 28, 1888, and records the adventures of the Expedition from June 28, 1887, until the time when the letter was written. There is no more stirring tale even in the long and romantic history of African exploration. On April 29, 1888, Mr. Stanley met Emin Pasha on the shores of the Albert Nyanza Lake, and it would be impossible to over-rate the courage, energy, and resource manifested by the great traveller in grappling with the terrible difficulties which had stood in his way. Having spent some time with Emin, Mr. Stanley returned to the Aruwimi River, and reorganized what remained of Major Barttelot's force. When the letter was despatched he was on the point of starting again for the Albert Nyanza, and we may have to wait some time for further intelligence. Next week we hope to give an account of the geographical results of the Expedition, so far as they are now known.

The Executive Committee of the International Exhibition of Geographical, Commercial, and Industrial Botany, to be held at Antwerp in 1890, has decided to celebrate on this occasion the three hundredth anniversary of the invention of the microscope. It proposes to organize what it calls a retrospective exhibition of the microscope, and an exhibition of instruments produced by living makers. Conferences relating to all important questions connected with the microscope will also be held. The Exhibition ought to be remarkably interesting, and will no doubt be a great success.

We are glad to hear that the Congress of the United States has recently provided for the establishment of a Zoological Park in the City of Washington, and has appropriated money for the purchase of a tract of land of not less than one hundred acres in extent, immediately adjacent to that city. The proposed site for the park is the valley of Rock Creek, a small river emptying into the Potomac at Washington. This is said to be one of the most picturesque sites ever devoted to such a purpose, having several rocky cliffs of considerable extent, groves of pine, oak, beech, and other trees, and several little streams running down the steep sides of the valley into the river. Part of the land is under cultivation, but much of it is virgin forest, so that its natural advantages have been preserved by singular good fortune in spite of the neighbourhood of the growing city. Amongst the animals to be kept here will, no doubt, be a herd of the buffalo (*Bison americanus*), now nearly extinct in the Western prairies.

The half-yearly general meeting of the Scottish Meteorological Society was held in the hall of the Royal Scottish Society of Arts, Edinburgh, on Monday, April 1. Next week we shall give some account of the proceedings. We are glad to learn from the Report of the Council that the application of the Society for a grant from the surplus fund of the Association of the Edinburgh International Exhibition of 1886 has been acceded to, the Association having granted the handsome donation of £1000 towards the completion of the Ben Nevis Observatory by the establishment of the Low Level Observatory at Fort William.

A frightful hurricane, which raged for nearly two days, broke over the Samoan Islands on the night of March 16. Of seven foreign war-vessels caught by the hurricane at Apia, only H.M.S. *Calliope* contrived to make the open sea. The German and American squadrons were destroyed, and many lives lost.

The meeting of the French Meteorological Society on the 5th of March was chiefly occupied by an analysis of the report of the Krakatão Committee, by M. L. Teisserenc de Bort. The Abbé Maze presented an apparatus for rotating a thermometer fixed in a framework, and intended to take the place of the sling-thermometer in cases in which the latter was inconvenient. The Society has received a circular from the Minister of Public Instruction, asking for a list of old manuscript observations, with a view to the preparation of a catalogue for publication.

Vapour-density determinations of bismuth, arsenic, and thallium have been successfully carried out at extraordinarily high temperatures in the laboratory of the University of Göttingen by Dr. Biltz and Prof. Victor Meyer. The highest temperature hitherto attained in former experiments by Dr. Mensching and Prof. Meyer lay somewhere between 1400° and 1500° C. Now, thanks to a suggestion of Prof. Nilson, of Stockholm, means have been found of raising the temperature of the Perrot gas furnace, in which the well-known Victor Meyer porcelain density apparatus was heated, to a white heat of 1650°–1750°. Hence there are now from 200 to 300 more degrees of temperature at which density determinations are possible, and it may naturally be expected that substances which were only partially vaporized at 1450° may yield definite results at 1750°. The temperatures were determined by means of a glazed porcelain air-thermometer, which was decisively proved to be impermeable to the furnace gases. In order to further strengthen that portion of the porcelain apparatus placed in the furnace, it was surrounded by an outer casing of platinum. The volatilizations were effected in atmospheres of nitrogen, all traces of oxygen being rigorously excluded. Bismuth was found in the former experiment to be only partially vaporized at 1450°. At the higher temperatures now available it has been found to be rapidly and completely volatilized, and density determinations have been readily carried out. The values obtained in two experiments at 1600°–1700° are 11·98 and 10·12 (air = 1). If the bismuth molecule in the gaseous state consists of the normal two atoms, Bi_2, its vapour-density should be 14·4; if it contains only one atom, Bi_1, the density becomes 7·2. The values obtained, which are considerably less than that required for the normal molecular condition, show that this condition is impossible, and bismuth therefore resembles mercury, cadmium, and zinc, in containing only one atom to the molecule. In the case of arsenic the results agree very well with the assumption of a two-atom molecule, As_2. At 1714° the density found was 5·45; and at 1736°, 5·37. As_2 requires 5·20. Hence the four-atom molecule of arsenic at lower temperatures becomes dissociated about 1750° into the normal molecule consisting of two atoms. Thallium appears to be at once normal. At 1636° the value obtained was 16·11; and at 1728°, 14·25. The ordinary molecule Tl_2 corresponds to 14·17. The metal, however, is still difficultly vaporizable even at this tremendous temperature. Another very interesting result was obtained in case of cuprous chloride, which even at 1700° gave densities almost exactly corresponding to the formula Cu_2Cl_2. Sulphur, iodine, and mercury also gave results confirming the stability of molecules consisting of two atoms of sulphur and single-atom molecules of iodine and mercury.

Mr. C. G. Hall, of Dover, sends to the new number of the *Entomologist's Monthly Magazine* the following note, written by the late moth-collector, Mr. H. J. Harding:—"On a beautiful evening at the end of June 1852, in the locality of Darenth Wood, I had just pinned my first insects taken at sugar, when I heard a strange sound behind me, and, on looking round, observed what I thought was a beetle flying round a sallow bush; when in my net, it again repeated the sound, but what was my surprise upon finding it a Lepidopterous insect. I had now got it between my thumb and finger to give it an entomological pinch, when it again produced the sound; the deadly pin was now presented, and, with the aid of my lantern, I found it was a common *Halias prasinana*. But it was a fact new to me: I I had never, during thirty years entomologizing, heard of such a thing before. The sound was as if you passed a pin sharply along three or four teeth of a comb. I suppose it was a love song to charm his lady."

Recently there have been some valuable "finds" of antiquities belonging to the Iron Age in Norway. At Nötterö, on the Christiania Fjord, there were found in a mound some bones, an iron pot with handles, a sword 2 feet 6 inches long, the handle having knobs of a yellow metal, an anvil, and a pair of smith's tongs. The mound was no doubt at one time situated close to the sea; it is now some 300 yards inland. At Laurvig a large number of similar articles were discovered in two mounds.

In a Report, just received, Mr. R. L. Jack, Government Geologist, Queensland, gives a valuable account of the geology of the Russell River, which he lately visited with Mr. Christie Palmerston. They were accompanied by eight "aboriginal boys," and Mr. Jack incidentally presents a vivid description of these attendants, who (with one exception) had been, eighteen months before, "absolute savages." "I observed with some interest," says Mr. Jack, "Mr. Palmerston's method of 'working' his boys. Its essential elements seemed to be giving them time, feeding them well, and keeping them in good humour by allowing for their propensities to hunt or play, and by making fun with them. It is fortunately unnecessary to be a Joe Miller to keep the boys amused, as anything which would amuse children will serve the purpose as well as the most delicate jokes. Mr. Palmerston's method is evidently successful, as I never saw more contented, willing, useful, and well-bred young men of any nationality."

DR. FRANZ BOAS contributes to the Proceedings of the U.S. National Museum an interesting paper on the houses of the Kwakiutl Indians, British Columbia. In these houses, the uprights are always carved according to the crest of the gens of the house-owner. The Indians of the present time make various combinations of the emblems of the gentes of both parents of the house-owner, and this is the reason for the great variety of forms. Besides this, legends referring to certain ancestors are illustrated in the emblems, and thus it happens that seemingly the ancient styles are not strictly adhered to.

AT a recent meeting of the Swedish Anthropological Society, Prof. G. Storm read a paper on his researches relating to the Lapps. The speaker held that this race had settled in Northern Scandinavia as far back as the Stone Age, and had not begun to move southwards until the Middle Ages. These southward movements had occurred periodically. At the end of the fifteenth century the Lapps had reached the sixty-fourth degree of latitude, but were now found much further south. The subject was of interest, because of the general belief that the Scandinavians had driven the Lapps northwards. In common with others, Prof. Storm was of opinion that the Lapps belonged to the Finnish-Ugrian race.

THE Dundee and District Association for the Promotion of Technical and Commercial Education have issued an elaborate Report on education in Dundee and the neighbourhood. They bring together a mass of facts which afford "abundant and gratifying evidence of a growing appreciation of science studies." The Committee, however, point out that the increase of attendance at science classes is chiefly in the elementary stages of the different subjects. More advanced classes are small, or do not exist at all. Classes in the higher branches of mathematics, physics, chemistry, and engineering have been most abundantly provided for at the Dundee University College, and the Committee hope that a very large increase in the numbers attending these may in the immediate future be the result of the elementary teaching which is now so widely appreciated.

THE Royal University of Ireland has issued its Calendar for the year 1889. The papers set at the examinations in 1888 have already been published in a separate volume, and form a supplement to the Calendar.

PROF. ANGELO HEILPRIN has contributed to the Proceedings of the Academy of Natural Sciences of Philadelphia some valuable notes on the zoology of the Bermuda Islands. These notes are based on personal observations, and on collections made during a recent brief sojourn on the islands in company with a class of students from the Academy of Natural Sciences. Prof. Heilprin devoted much time to the study of the geological features of the Bermudas. The results of his work in this department he will embody in a future paper.

AT the annual meeting of the Asiatic Society of Bengal, on February 6, an address was delivered by the President, Colonel J. Waterhouse. This address has now been printed. It contains an interesting review of the progress of science and Oriental literature in India and its nearer border-lands during the year 1888.

WE have received Parts IV. and V. of "A Catalogue of the Moths of India," compiled by Mr. E. C. Cotes and Colonel C. Swinhoe. The subjects dealt with are Geometrites and Pyrales.

TWO works on palæontology are now being issued, in parts, in Germany: "Handbuch der Palæontologie," by Dr. A. Schenk and Prof. K. A. Zittel; and "Elemente der Palæontologie," by Dr. G. Steinmann and Dr. L. Döderlein. The former work is published by R. Oldenbourg, Munich and Leipzig; the latter by W. Engelmann, Leipzig.

ONE of the Johns Hopkins University Circulars, for March, contains the following morphological notes from the biological laboratory of the University: a preliminary abstract of researches by W. K. Brooks and F. H. Herrick on the life history of Stenopus, by W. K. Brooks; list of Actiniaria found at New Providence, Bahama Islands, by J. Playfair McMurrich; on the occurrence of an Edwardsia stage in the free-swimming embryos of a Hexactinian, by J. Playfair McMurrich; notes on the fate of the amphibian blastopore, by T. H. Morgan; on the anatomy and histology of *Cymbuliopsis calcœla*, by J. I. Peck; on a new phenomenon of cleavage in the ovum of the Cephalopod, by S. Watase; on the structure and development of the eyes of the Limulus, by S. Watase; notes on the embryology of *Mülleria agassizii*, Tel., a Holothurian common at Green Turtle Cay, Bahamas, by Charles L. Edwards; on the occasional presence of a mouth and anus in the Actinozoa, by Henry V. Wilson; on the breeding-seasons of marine animals in the Bahamas, by Henry V. Wilson; the multiplication of Bryophyllum, by B. W. Barton; notice of Dr. H. V. Wilson's paper on the development of *Manicina areolata*, by T. H. Morgan; report of Dr. Henry V. Wilson as Bruce Fellow of the Johns Hopkins University.

THE Royal Society of Victoria prints an alphabetical list of the genera and species of Sponges described by Mr. H. J. Carter, F.R.S., together with a number of his more important references to those of other authors, with an introductory notice, by Mr. Arthur Dendy, Demonstrator and Assistant Lecturer in Biology in the University of Melbourne.

ON Tuesday evening Prof. Raphael Meldola delivered an interesting lecture at the Royal Victoria Hall on "Insects in Disguise, and on Mimicry," to an audience of about 500 persons, chiefly working men. Many illustrations, lent by Mr. Poulton, were thrown upon the screen, and were much appreciated. The following lectures will also be delivered at the Royal Victoria Hall:—Tuesday, April 9, "Polarized Light," by Prof. Silvanus Thompson; Tuesday, April 16, "Electric Tram-cars," by Dr. Heming.

THE additions to the Zoological Society's Gardens during the past week include a Spanish Terrapin (*Clemmys leprosa*), South European, presented by Mr. F. T. Mason; two Tuatera Lizards (*Sphenodon punctatus*) from New Zealand, a Long-billed Butcher Bird (*Barita destructor*) from New Holland, deposited; a Common Otter (*Lutra vulgari* ♂), British, two Black-necked Storks (*Xenorhynchus australis* ♂ ♀), from Malacca, a Teguexin Lizard (*Teius teguexin*) from South America, purchased; an Alleghany Snake (*Coluber alleghaniensis*) from North America, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE ASTRONOMICAL SOCIETY OF THE PACIFIC.—The increased interest in astronomy which has been felt in California in consequence of the erection of the Lick Observatory, and perhaps even more widely from the recent solar eclipse, which was so well and widely observed in the State, has led to the formation of an Astronomical Society under the above title. The Society was organized at a meeting held on February 7, 1889, and Prof. Holden was appointed interim President,